Amendments to the Claims

This listing of claims will replace all prior versions, and listings of claims in the application.

Claims 1 - 219 (cancelled).

220. (Currently amended) A composition comprising:

(a) a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA

(ii) an organizer comprising at least one first attachment site, wherein said organizer is connected to said core particle by at least one covalent bond; and wherein said first attachment site is not a sulfhydryl group; and

(b) an antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or fragment thereof, wherein said self antigen is not amyloid β or a peptide or fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

wherein said antigen or antigenic determinant and said scaffold interact through said association to form an ordered and repetitive antigen array.

221. (Preivously presented) The composition of claim 220, wherein said RNA bacteriophage is selected from the group consisting of:

(a) bacteriophage Qβ;

(b) bacteriophage R17;

(c) bacteriophage fr;

(d) bacteriophage GA;

(e) bacteriophage SP;

(f) bacteriophage MS2;

(g) bacteriophage M11;

(h) bacteriophage MX1;

(i) bacteriophage NL95;

(j) bacteriophage f2; and

(k) bacteriophage PP7.

222. (Previously presented) The composition of claim 220, wherein said bacteriophage is bacteriophage Qβ.

223. (Previously presented) The composition of claim 220, wherein said bacteriophage is bacteriophage fr.

224. (Previously presented) The composition of claim 220, wherein said bacteriophage is bacteriophage GA.

225. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant proteins, or fragments thereof, of an RNA bacteriophage.

226. (Previously presented) The composition of claim 225, wherein said bacteriophage is bacteriophage Qβ.

227. (Previously presented) The composition of claim 225, wherein said bacteriophage is bacteriophage fr.

228. (Previously presented) The composition of claim 225, wherein said bacteriophage is bacteriophage GA.

229. (Previously presented) The composition of claim 225, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant proteins, or fragments thereof, of an RNA bacteriophage.

230. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

231. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

232. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins having an

amino acid sequence of SEQ ID NO:159, or a mixture of coat proteins having amino acid sequences of SEQ ID NO:159 and of SEQ ID NO:217.

233. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage consists essentially of coat proteins having an amino acid sequence of SEQ ID NO:159, or consists essentially of a mixture of coat proteins having amino acid sequences of SEQ ID NO:217 and of SEQ ID NO:159.

234. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins of said RNA bacteriophage that have been modified by deletion or substitution to remove at least one naturally occurring lysine residue, or that have been modified by insertion or substitution to add at least one lysine residue.

235. (Previously presented) The composition of claim 234, wherein said RNA bacteriophage is Qβ.

236. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

237. (Previously presented) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins consisting essentially of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

238. (Previously presented) The composition of claim 220, wherein said organizer is an integral part of said RNA bacteriophage.

239. (Previously presented) The composition of claim 220, wherein said organizer is a polypeptide or residue thereof and said second attachment site is a polypeptide or residue thereof.

240. (Previously presented) The composition of claim 220, wherein said association is by way of at least one covalent bond.

241. (Previously presented) The composition of claim 220, further comprising an amino acid linker.

242. (Previously presented) The composition of claim 241, wherein said amino acid linker is bound to said antigen or said antigenic determinant by way of at least one covalent bond.

243. (Previously presented) The composition of claim 242, wherein said covalent bond is a peptide bond.

244. (Previously presented) The composition of claim 241, wherein said amino acid linker comprises said second attachment site.

245. (Previously presented) The composition of claim 241, wherein said amino acid linker is selected from the group consisting of:

(a) CGG;

(b) an N-terminal gamma 1-linker;

(c) an N-terminal gamma 3-linker;

(d) an Ig hinge region;

(e) an N-terminal glycine linker;

(f) $(G)_kC(G)_n$ with n=0-12 and k=0-5;

(g) an N-terminal glycine-serine linker;

(h) $(G)_kC(G)_m(S)_l(GGGGS)_n$ with n=0-3, k=0-5, m=0-10, l=0-2 (SEQ ID NO: 424);

(i) GGC;

(j) GGC-NH2;

(k) a C-terminal gamma 1-linker;

(l) a C-terminal gamma 3-linker;

(m) a C-terminal glycine linker;

(n) $(G)_nC(G)_k$ with n=0-12 and k=0-5;

(o) a C-terminal glycine-serine linker; and

(p) $(G)_m(S)_l(GGGGS)_n(G)_oC(G)_k$ with n=0-3, k=0-5, m=0-10, l=0-2, and o=0-8 (SEQ ID NO: 425).

246. (Previously presented) The composition of claim 241, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

247. (Previously presented) The composition of claim 220, wherein said first and said second attachment sites comprise an interacting pair selected from the group consisting of:

(a) an antigen and an antibody or antibody fragment thereto;

(b) biotin and avidin;

(c) streptavidin and biotin;

(d) a receptor and its ligand;

(e) a ligand-binding protein and its ligand;

(f) interacting leucine zipper polypeptides;

(g) an amino group and a chemical group reactive thereto;

(h) a carboxyl group and a chemical group reactive thereto; and

(i) a combination thereof of any of (a)-(h).

248. (Previously presented) The composition of claim 220, wherein said first attachment site and said second attachment site are associated through a heterobifunctional linker.

249. (Previously presented) The composition of claim 248, wherein said heterobifunctional linker is selected from the group consisting of:

(a) a maleimidocaproic acid N-hydroxysuccinimide ester;

(b) N-Succinimidyl 3-(2-pyridyldithio) propionate (SPDP); and

(c) Sulfo-MBS.

250. (Previously presented) The composition of claim 220, wherein said first attachment site comprises an amino group and said second attachment site comprises a sulfhydryl group.

251. (Previously presented) The composition of claim 220, wherein said first attachment site is an amino group and said second attachment site is a sulfhydryl group.

252. (Previously presented) The composition of claim 220, wherein said first attachment site is a lysine residue and said second attachment site is a cysteine residue.

253. (Previously presented) The composition of claim 220, wherein said first attachment site comprises a lysine residue.

254. (Previously presented) The composition of claim 220, wherein said first attachment site is a lysine residue.

255. (Previously presented) The composition of claim 220, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

256. (Previously presented) The composition of claim 220, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

257. (Previously presented) The composition of claim 220, wherein said second attachment site is a sulfhydryl group or is a cysteine residue.

258. (Previously presented) The composition of claim 220, wherein said self antigen is selected from the group consisting of:

(a) a lymphotoxin;

(b) a lymphotoxin receptor;

(c) RANKL;

(d) VEGF;

(e) VEGFR;

(f) Interleukin-5;

(g) Interleukin-17;

(h) Interleukin-13;

(i) Angiotensin;

(j) CCL21;

(k) CXCL12;

(l) SDF-1;

(m) MCP-1;

(n) Endoglin;

(o) Resistin;

(p) GHRH;

(q) LHRH;

(r) TRH;

(s) MIF;

(t) Eotaxin;

(u) Bradykinin;

(v) BLC;

(w) Tumor Necrosis Factor-α (TNF-α);

(x) a human IgE; and

(y) peptides or fragments of any of (a) through (x).

259. (Previously presented) The composition of claim 220, wherein said self antigen is angiotensin.

260. (Previously presented) The composition of claim 259, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

261. (Previously presented) The composition of claim 259, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

262. (Previously presented) The composition of claim 259, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

263. (Cancelled)

264. (Cancelled)

265. (Previously presented) The composition of claim 259, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

266. (Previously presented) The composition of claim 259, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

267. (Previously presented) The composition of claim 259, wherein said self antigen with said second attachment site consists of the amino acid sequence CGGDRVYIHPF (SEQ ID NO: 380).

268. (Previously presented) The composition of claim 220, wherein said self antigen is VEGFR-II.

269. (Previously presented) The composition of claim 268, wherein said self antigen is human VEGFR-II.

270. (Previously presented) The composition of claim 268, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

271. (Previously presented) The composition of claim 268, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

272. (Previously presented) The composition of claim 268, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

273. (Cancelled)

274. (Cancelled)

275. (Previously presented) The composition of claim 268, wherein said self antigen with said second attachment site comprises the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

276. (Previously presented) The composition of claim 268, wherein said self antigen with said second attachment site consists of the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

277. (Previously presented) The composition of claim 220, wherein said self antigen is tumor necrosis factor-α (TNF-α).

278. (Previously presented) The composition of claim 277, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

279. (Previously presented) The composition of claim 277, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

280. (Previously presented) The composition of claim 277, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

281. (Cancelled)

282. (Cancelled)

283. (Previously presented) The composition of claim 277, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399); and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

284. (Previously presented) The composition of claim 277, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399); and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

285. (Previously presented) The composition of claim 220, wherein said self antigen is resistin.

Claims 286-291. (Cancelled).

292. (Previously presented) The composition of claim 285, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:325

(b) SEQ ID NO:326; and

(c) SEQ ID NO:327.

293. (Previously presented) The composition of claim 220, wherein said self antigen is a lymphotoxin.

294. (Previously presented) The composition of claim 293, wherein said lymphotoxin is selected from the group consisiting of:

(a) lymphotoxin α (LTα);

(b) lymphotoxin β (LTβ); and

(c) a mixture or combination of LTα and LTβ.

295. (Previously presented) The composition of claim 293, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

296. (Previously presented) The composition of claim 293, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

297. (Previously presented) The composition of claim 293, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

298. (Cancelled).

299. (Cancelled).

300. (Previously presented) The composition of claim 293, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

301. (Previously presented) The composition of claim 293, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

302. (Previously presented) The composition of claim 220, wherein said self antigen is MIF.

303. (Previously presented) The composition of claim 302 wherein self antigen is human-MIF.

304. (Previously presented) The composition of claim 302, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

305. (Previously presented) The composition of claim 302, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

306. (Previously presented) The composition of claim 302, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

307. (Cancelled).

308. (Cancelled).

309. (Previously presented) The composition of claim 302, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:310;

(b) SEQ ID NO:311;

(c) SEQ ID NO:312;

(d) SEQ ID NO:313;

(e) SEQ ID NO:314; and

(f) SEQ ID NO:315.

310. (Previously presented) The composition of claim 302, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:310;

(b) SEQ ID NO:311;

(c) SEQ ID NO:312;

(d) SEQ ID NO:313;

(e) SEQ ID NO:314; and

(f) SEQ ID NO:315.

311. (Previously presented) The composition of claim 220, wherein said self antigen is RANKL.

312. (Previously presented) The composition of claim 311, wherein said self antigen is human-RANKL.

313. (Previously presented) The composition of claim 311, wherein said self antigen is an extracellular domain of RANKL.

314. (Previously presented) The composition of claim 311, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

315. (Previously presented) The composition of claim 311, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

316. (Previously presented) The composition of claim 311, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

317. (Cancelled).

318. (Cancelled).

319. (Previously presented) The composition of claim 311, wherein said self antigen with said second attachment site comprises the amino acid sequence of SEQ ID NO:320.

320. (Previously presented) The composition of claim 311, wherein said self antigen with said second attachment site consists of the amino acid sequence of SEQ ID NO:320.

Claims 321-328. (Cancelled).

329. (Previously presented) The composition of claim 220, wherein said self antigen is IgE.

330. (Previously presented) The composition of claim 329, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

331. (Previously presented) The composition of claim 329, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

332. (Previously presented) The composition of claim 329, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

333. (Cancelled).

334. (Cancelled).

335. (Previously presented) The composition of claim 329, wherein said IgE with said second attachment site comprises the amino acid sequence of SEQ ID NO:176.

336. (Previously presented) The composition of claim 329, wherein said IgE with said second attachment site consists of the amino acid sequence of SEQ ID NO:176.

337. (Previously presented) The composition of claim 220, wherein said self antigen is a lymphotoxin receptor.

338. (Previously presented) The composition of claim 220, wherein said self antigen is VEGF.

339. (Previously presented) The composition of claim 220, wherein said self antigen is Interleukin-5.

340. (Previously presented) The composition of claim 220, wherein said self antigen is Interleukin-17.

341. (Previously presented) The composition of claim 220, wherein said self antigen is Interleukin-13.

342. (Previously presented) The composition of claim 220, wherein said self antigen is CCL21.

343. (Previously presented) The composition of claim 220, wherein said self antigen is CXCL12.

344. (Previously presented) The composition of claim 220, wherein said self antigen is SDF-1.

345. (Previously presented) The composition of claim 220, wherein said self antigen is MCP-1.

346. (Previously presented) The composition of claim 220, wherein said self antigen is Endoglin.

347. (Previously presented) The composition of claim 220, wherein said self antigen is GHRH.

348. (Previously presented) The composition of claim 220, wherein said self antigen is LHRH.

349. (Previously presented) The composition of claim 220, wherein said self antigen is TRH.

350. (Previously presented) The composition of claim 220, wherein said self antigen is Eotaxin.

351. (Previously presented) The composition of claim 220, wherein said self antigen is Bradykinin.

352. (Previously presented) The composition of claim 220, wherein said self antigen is BLC.

353. (Previously presented) The composition of claim 220, wherein said self antigen is suitable to induce an immune response against cancer cells.

354. (Previously presented) The composition of claim 353, wherein said self antigen is:

(a) a protein of breast cancer cells;

(b) a protein of kidney cancer cells;

(c) a protein of prostate cancer cells;

(d) a protein of skin cancer cells;

(e) a protein of brain cancer cells; or

(f) a protein of leukemia cells.

355. (Previously presented) A pharmaceutical composition comprising:

(a) the composition of claim 220; and

(b) an acceptable pharmaceutical carrier.

356. (Previously presented) A method of immunization of an animal comprising administering to said animal the composition of claim 220, wherein an immune response against said antigen or antigenic determinant is produced in said animal.

357. (Previously presented) An immunogenic composition comprising the composition of claim 220 and an adjuvant.

358. (Previously presented) A method of immunization of an animal comprising administering to said animal the composition of claim 357, wherein an immune response against said antigen or antigenic determinant is produced in said animal.

359. (Currently amended) A process for producing a non-naturally occurring, ordered and repetitive antigen array comprising:

(a) providing a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA bacteriophage; and

(ii) an organizer comprising at least one first attachment site,

wherein said organizer is connected to said core particle by at least one covalent bond, and wherein said first attachment site is not a sulfhydryl group; and

(b) providing an antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or a fragment thereof, and wherein said self antigen is not amyloid β or a peptide or fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

(c) combining said non-natural molecular scaffold and said antigen to form an ordered and repetitive antigen array.

360. (Previously presented) The process of claim 359, wherein said organizer is a polypeptide or residue thereof; and wherein said second attachment site is a polypeptide or residue thereof.

361. (Previously presented) The process of claim 359, wherein said association is by way of at least one covalent bond.

362. (Previously presented) A composition comprising:

(a) a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA bacteriophage; and

(ii) an organizer comprising at least one first attachment site,

wherein said organizer is connected to said core particle by at least one covalent bond; and

(b) an antigen or antigenic determinant with at least one second attachment

site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

wherein said antigen or antigenic determinant and said scaffold interact through said association to form an ordered and repetitive antigen array, and

wherein said self antigen, peptide or fragment thereof is selected from the group consisting of :

(a) a lymphotoxin;

(b) a lymphotoxin receptor;

(c) RANKL;

(d) VEGF;

(e) VEGFR;

(f) Interleukin-5;

(g) Interleukin-17;

(h) Interleukin-13;

(i) Angiotensin;

(j) CCL21;

(k) CXCL12;

(l) SDF-1;

(m) MCP-1;

(n) Endoglin;

(o) Resistin;

(p) GHRH;

(q) TRH;

(r) MIF;

(s) Eotaxin;

(t) Bradykinin;

(u) BLC; and

(v) Tumor Necrosis Factor-α (TNF-α).

363. (Previously presented) The composition of claim 362, wherein said RNA bacteriophage is selected from the group consisting of:

(a) bacteriophage Qβ;

(b) bacteriophage R17;

(c) bacteriophage fr;

(d) bacteriophage GA;

(e) bacteriophage SP;

(f) bacteriophage MS2;

(g) bacteriophage M11;

(h) bacteriophage MX1;

(i) bacteriophage NL95;

(j) bacteriophage f2; and

(k) bacteriophage PP7.

364. (Previously presented) The composition of claim 362, wherein said bacteriophage is bacteriophage Qβ.

365. (Previously presented) The composition of claim 362, wherein said bacteriophage is bacteriophage fr.

366. (Previously presented) The composition of claim 362, wherein said bacteriophage is bacteriophage GA.

367. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises recombinant proteins, or fragments thereof, of an RNA bacteriophage.

368. (Previously presented) The composition of claim 367, wherein said bacteriophage is bacteriophage Qβ.

369. (Previously presented) The composition of claim 367, wherein said bacteriophage is bacteriophage fr.

370. (Previously presented) The composition of claim 367, wherein said bacteriophage is bacteriophage GA.

371. (Previously presented) The composition of claim 367, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant proteins, or fragments thereof, of an RNA bacteriophage.

372. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

373. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

374. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins having an amino acid sequence of SEQ ID NO:159, or a mixture of coat proteins having amino acid sequences of SEQ ID NO:159 and of SEQ ID NO:217.

375. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage consists essentially of coat proteins having an amino acid sequence of SEQ ID NO:159, or consists essentially of a mixture of coat proteins having amino acid sequences of SEQ ID NO:217 and of SEQ ID NO:159.

376. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins of said RNA bacteriophage that have been modified by deletion or substitution to remove at least one

naturally occurring lysine residue, or that have been modified by insertion or substitution to add at least one lysine residue.

377. (Previously presented) The composition of claim 376, wherein said RNA bacteriophage is Qβ.

378. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

379. (Previously presented) The composition of claim 362, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins consisting essentially of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

380. (Previously presented) The composition of claim 362, wherein said organizer is an integral part of said RNA bacteriophage.

381. (Previously presented) The composition of claim 362, wherein said organizer is a polypeptide or residue thereof and said second attachment site is a polypeptide or residue thereof.

382. (Previously presented) The composition of claim 362, wherein said association is by way of at least one covalent bond.

383. (Previously presented) The composition of claim 362, further comprising an amino acid linker.

384. (Previously presented) The composition of claim 383, wherein said amino acid linker is bound to said antigen or said antigenic determinant by way of at least one covalent bond.

385. (Previously presented) The composition of claim 384, wherein said covalent bond is a peptide bond.

386. (Previously presented) The composition of claim 383, wherein said amino acid linker comprises said second attachment site.

387. (Previously presented) The composition of claim 383, wherein said amino acid linker is selected from the group consisting of:

(a) CGG;

(b) an N-terminal gamma 1-linker;

(c) an N-terminal gamma 3-linker;

(d) an Ig hinge region;

(e) an N-terminal glycine linker;

(f) $(G)_kC(G)_n$ with n=0-12 and k=0-5;

(g) an N-terminal glycine-serine linker;

(h) $(G)_kC(G)_m(S)_l(GGGGS)_n$ with n=0-3, k=0-5, m=0-10, l=0-2 (SEQ ID NO: 424);

(i) GGC;

(j) GGC-NH2;

(k) a C-terminal gamma 1-linker;

(l) a C-terminal gamma 3-linker;

(m) a C-terminal glycine linker;

(n) $(G)_nC(G)_k$ with n=0-12 and k=0-5;

(o) a C-terminal glycine-serine linker; and

(p) $(G)_m(S)_l(GGGGS)_n(G)_oC(G)_k$ with n=0-3, k=0-5, m=0-10, l=0-2, and o=0-8 (SEQ ID NO: 425).

388. (Previously presented) The composition of claim 383, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

389. (Previously presented) The composition of claim 362, wherein said first and said second attachment sites comprise an interacting pair selected from the group consisting of:

(a) an antigen and an antibody or antibody fragment thereto;

(b) biotin and avidin;

(c) streptavidin and biotin;

(d) a receptor and its ligand;

(e) a ligand-binding protein and its ligand;

(f) interacting leucine zipper polypeptides;

(g) an amino group and a chemical group reactive thereto;

(h) a carboxyl group and a chemical group reactive thereto; and

(i) a combination thereof of any of (a)-(h).

390. (Previously presented) The composition of claim 362, wherein said first attachment site and said second attachment site are associated through a heterobifunctional linker.

391. (Previously presented) The composition of claim 390, wherein said heterobifunctional linker is selected from the group consisting of:

(a) a maleimidocaproic acid N-hydroxysuccinimide ester;

(b) N-Succinimidyl 3-(2-pyridyldithio) propionate (SPDP); and

(c) Sulfo-MBS.

392. (Previously presented) The composition of claim 362, wherein said first attachment site comprises an amino group and said second attachment site comprises a sulfhydryl group.

393. (Previously presented) The composition of claim 362, wherein said first attachment site is an amino group and said second attachment site is a sulfhydryl group.

394. (Previously presented) The composition of claim 362, wherein said first attachment site is a lysine residue and said second attachment site is a cysteine residue.

395. (Previously presented) The composition of claim 362, wherein said first attachment site comprises a lysine residue.

396. (Previously presented) The composition of claim 362, wherein said first attachment site is a lysine residue.

397. (Previously presented) The composition of claim 362, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

398. (Previously presented) The composition of claim 362, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

399. (Previously presented) The composition of claim 362, wherein said second attachment site is a sulfhydryl group or is a cysteine residue.

400. (Previously presented) The composition of claim 362, wherein said first attachment site does not comprise a sulfhydryl group.

401. (Previously presented) The composition of claim 362, wherein said first attachment site is not a sulfhydryl group.

402. (Previously presented) The composition of claim 220, wherein said first attachment site does not comprise a sulfhydryl group.

403. (Previously presented) The composition of claim 362, wherein said association does not comprise a disulfide bond.

404. (Previously presented) The composition of claim 220, wherein said association does not comprise a disulfide bond.

405. (Previously presented) The composition of claim 362, wherein said self antigen is angiotensin.

406. (Previously presented) The composition of claim 405, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

407. (Previously presented) The composition of claim 405, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

408. (Previously presented) The composition of claim 405, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

409. (Previously presented) The composition of claim 405, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

410. (Previously presented) The composition of claim 405, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

411. (Previously presented) The composition of claim 405, wherein said self antigen with said second attachment site consists of the amino acid sequence CGGDRVYIHPF (SEQ ID NO: 380).

412. (Previously presented) The composition of claim 362, wherein said self antigen is VEGFR-II.

413. (Previously presented) The composition of claim 412, wherein said self antigen is human VEGFR-II.

414. (Previously presented) The composition of claim 412, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

415. (Previously presented) The composition of claim 412, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

416. (Previously presented) The composition of claim 412, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

417. (Previously presented) The composition of claim 412, wherein said self antigen with said second attachment site comprises the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

418. (Previously presented) The composition of claim 412, wherein said self antigen with said second attachment site consists of the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

419. (Previously presented) The composition of claim 362, wherein said self antigen is tumor necrosis factor-α (TNF-α).

420. (Previously presented) The composition of claim 419, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

421. (Previously presented) The composition of claim 419, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

422. (Previously presented) The composition of claim 419, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

423. (Previously presented) The composition of claim 419, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399);

and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

424. (Previously presented) The composition of claim 419, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399);

and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

425. (Previously presented) The composition of claim 362, wherein said self antigen is resistin.

426. (Previously presented) The composition of claim 425, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:325

(b) SEQ ID NO:326; and

(c) SEQ ID NO:327.

427. (Previously presented) The composition of claim 362, wherein said self antigen is a lymphotoxin.

428. (Previously presented) The composition of claim 427, wherein said lymphotoxin is selected from the group consisiting of:

(a) lymphotoxin α (LTα);

(b) lymphotoxin β (LTβ); and

(c) a mixture or combination of LTα and LTβ.

429. (Previously presented) The composition of claim 427, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

430. (Previously presented) The composition of claim 427, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

431. (Previously presented) The composition of claim 427, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker

comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

432. (Previously presented) The composition of claim 427, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

433. (Previously presented) The composition of claim 427, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

434. (Previously presented) The composition of claim 362, wherein said self antigen is MIF.

435. (Previously presented) The composition of claim 434, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:310;

(b) SEQ ID NO:311;

(c) SEQ ID NO:312;

(d) SEQ ID NO:313;

(e) SEQ ID NO:314; and

(f) SEQ ID NO:315.

436. (Previously presented) The composition of claim 362, wherein said self antigen is RANKL.

437. (Previously presented) The composition of claim 436, wherein said self antigen is human-RANKL.

438. (Previously presented) The composition of claim 436, wherein said self antigen is an extracellular domain of RANKL.

439. (Previously presented) The composition of claim 436, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

440. (Previously presented) The composition of claim 436, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

441. (Previously presented) The composition of claim 436, wherein said composition further comprises an amino acid linker, and wherein said amino acid linker comprises said second attachment site, and wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

442. (Previously presented) The composition of claim 436, wherein said self antigen with said second attachment site comprises the amino acid sequence of SEQ ID NO:320.

443. (Previously presented) The composition of claim 436, wherein said self antigen with said second attachment site consists of the amino acid sequence of SEQ ID NO:320.

444. (Previously presented) The composition of claim 362, wherein said self antigen is a lymphotoxin receptor.

445. (Previously presented) The composition of claim 362, wherein said self antigen is VEGF.

446. (Previously presented) The composition of claim 362, wherein said self antigen is Interleukin-5.

447. (Previously presented) The composition of claim 362, wherein said self antigen is Interleukin-17.

448. (Previously presented) The composition of claim 362, wherein said self antigen is Interleukin-13.

449. (Previously presented) The composition of claim 362, wherein said self antigen is CCL21.

450. (Previously presented) The composition of claim 362, wherein said self antigen is CXCL12.

451. (Previously presented) The composition of claim 362, wherein said self antigen is SDF-1.

452. (Previously presented) The composition of claim 362, wherein said self antigen is MCP-1.

453. (Previously presented) The composition of claim 362, wherein said self antigen is Endoglin.

454. (Previously presented) The composition of claim 362, wherein said self antigen is GHRH.

455. (Previously presented) The composition of claim 362, wherein said self antigen is TRH.

456. (Previously presented) The composition of claim 362, wherein said self antigen is Eotaxin.

457. (Previously presented) The composition of claim 362, wherein said self antigen is Bradykinin.

458. (Previously presented) The composition of claim 362, wherein said self antigen is BLC.

459. (Previously presented) A pharmaceutical composition comprising:

(a) the composition of claim 362; and

(b) an acceptable pharmaceutical carrier.

460. (Previously presented) A method of immunization of an animal comprising administering to said animal the composition of claim 362, wherein an immune response against said antigen or antigenic determinant is produced in said animal.

461. (Previously presented) An immunogenic composition comprising the composition of claim 362 and an adjuvant.

462. (Previously presented) A method of immunization of an animal comprising administering to said animal the composition of claim 461, wherein an immune response against said antigen or antigenic determinant is produced in said animal.

463. (Previously presented) A process for producing a non-naturally occurring, ordered and repetitive antigen array comprising:

(a) providing a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA bacteriophage; and

(ii) an organizer comprising at least one first attachment site,

wherein said organizer is connected to said core particle by at least one covalent bond;

(b) providing an antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or a fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

wherein said self antigen, peptide or fragment thereof is selected from the group consisting of :

(a) a lymphotoxin;

(b) a lymphotoxin receptor;

(c) RANKL;

(d) VEGF;

(e) VEGFR;

(f) Interleukin-5;

(g) Interleukin-17;

(h) Interleukin-13;

(i) Angiotensin;

(j) CCL21;

(k) CXCL12;

(l) SDF-1;

(m) MCP-1;

(n) Endoglin;

(o) Resistin;

(p) GHRH;

(q) TRH;

(r) MIF;

(s) Eotaxin;

(t) Bradykinin;

(u) BLC;

(v) Tumor Necrosis Factor-α (TNF-α); and

(c) combining said non-natural molecular scaffold and said antigen to form an ordered and repetitive antigen array.

464. (Previously presented) The process of claim 463, wherein said organizer is a polypeptide or residue thereof; and wherein said second attachment site is a polypeptide or residue thereof.

465. (Previously presented) The process of claim 463, wherein said association is by way of at least one covalent bond.